

**Instruction Sheet  
for the PASCO  
Model CI-6742**

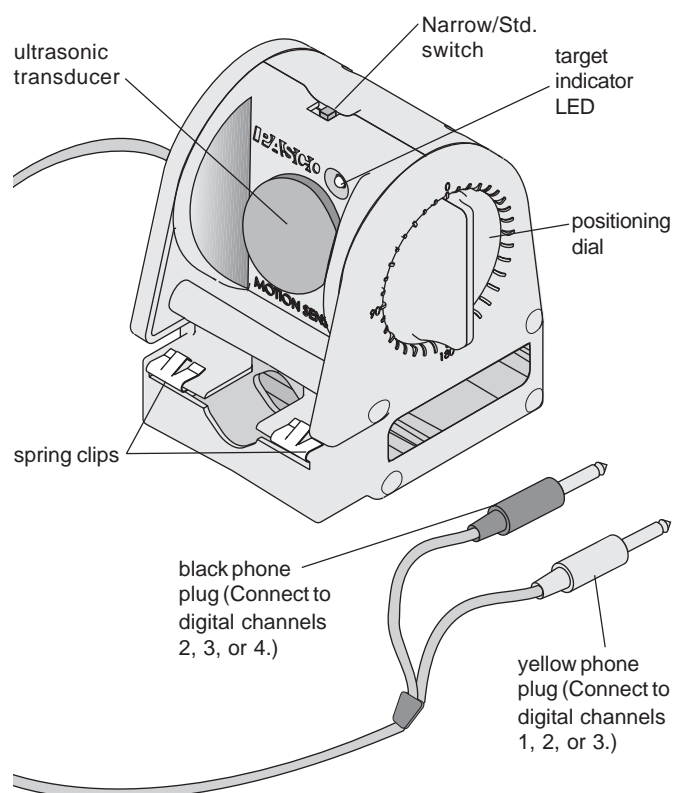
## Motion Sensor II

### Introduction

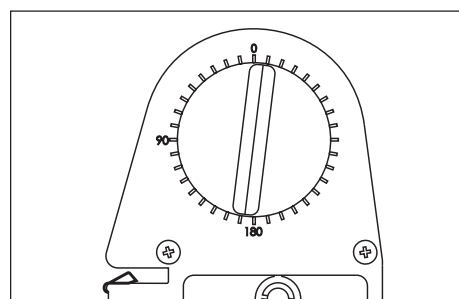
The PASCO CI-6742 Motion Sensor II is a sonar ranging device with a sensing range of 0.15 to about 8 meters. When used with an interface, the Motion Sensor II emits ultrasonic pulses and detects pulses returned as echoes from the target. The *ScienceWorkshop* program calculates the distance to the object from the speed of sound and half the sonic pulse round trip time. The program can also calculate velocity and acceleration from the distance and time measurements. The trigger rate for the Motion Sensor can be set in the *ScienceWorkshop* program to trigger as few as 5 times per second (for recording relatively slow events over large distances) or for as many as 120 times per second (for quick events such as a free-fall experiment).

The CI-6742 Motion Sensor II has several improved features, compared to the CI-6529 Motion Sensor:

- reduced minimum distance of operation
- reduced sensitivity to false targets
- front panel LED that lights when the Motion Sensor acquires the target
- additional mounting and positioning options
- compatibility with Texas Instruments® and Casio® scientific calculator-sensor interfaces
- compatibility with ULI interfaces



**Important Operating Note:** When operating in the Std. mode, it may be necessary to tilt the transducer up 5-10 degrees for best performance, as shown.



## Equipment

### Included:

- PASCO CI-6742 Motion Sensor II
- detachable cable with two color-coded phone plugs

### Additional Equipment Required:

- computer and *ScienceWorkshop 500, 700, or 750* Interface  
or
- scientific calculator and sensor interface (Texas Instruments or Casio) and cable (PASCO part no. 514-06862)  
or
- ULI Interface and cable (PASCO part no. 514-06933)

## Using the Motion Sensor II

1. Insert the yellow phone plug into digital channel 1 (or 1, 2, or 3 for *ScienceWorkshop* series 700 and 750 interfaces). Insert the black phone plug into digital channel 2 (or 2, 3, or 4 for *Science Workshop* series 700 and 750 interfaces).

**Note:** The Motion Sensor can be connected to any two adjacent digital channels on the interface, with the yellow plug in the channel with the lower number. The yellow plug carries the transmit signal from the *ScienceWorkshop* interface to the sensor, and the black plug carries the return, echo signal, from the sensor to the *Science Workshop* interface.

2. Run the *ScienceWorkshop* program. In the Experiment Setup window, set up the *ScienceWorkshop* interface and sensor so the Motion Sensor is connected to the correct digital channels of the interface.

**Note:** You can set up the Motion Sensor II in *ScienceWorkshop* program (2.x series) by dragging the digital plug icon to channel 1 if the phone plugs are inserted into channels 1 and 2 on the interface box, or by double-clicking the Motion Sensor icon in the list of sensors (3.x series).

**Note:** With the 700 and 750 interfaces, two Motion Sensors may be used at the same time.

3. Set the *Narrow/Standard (Std.)* switch based on your application. For experiments that involve sensing distances of 2 meters or less with highly reflective targets (such as a typical Dynamics Track experiment), set the switch to *Narrow*. This setting reduces sensitivity to false targets near the track and sensitivity to air track noise. For experiments that involve longer distances or poorly reflecting targets (such as match-graph experiments), set the switch to *Std.*

**Note:** When using the *Std.* switch setting it may be necessary to tilt the sensor up 5-10 degrees to avoid seeing reflections from a table surface or the front of the housing as a target.

4. For most experiments, the internal calibration in *ScienceWorkshop* will be adequate. However for maximum accuracy the Motion Sensor II may be calibrated as follows:

- a. Double-click on the Motion Sensor icon to open the Digital Sensor Setup dialog box.
- b. Aim the Motion Sensor II at a stationary target one meter away (the default calibration distance).
- c. Click **Calibrate**. The Motion Sensor II will click a few times per second during the calibration process. The program will calculate the speed of sound based on the default calibration distance (one meter) and the round trip time of the pulses and echoes.

**Note:** If the Motion Sensor does not detect a target, the Interface may stop trying to calibrate. Should this occur, realign the target of the sensor and try again.

5. Change the trigger rate (if necessary) by clicking the *up/down* arrows to the right of the Trigger Rate pop-up menu, or click the pop-up menu and select the Trigger Rate you need. (The Trigger Rate may need to be increased from the default 20 Hz for fast events like collisions or free-fall experiments in order to achieve the necessary resolution.)

6. Open a Graph display in *ScienceWorkshop*.

7. Start monitoring data.

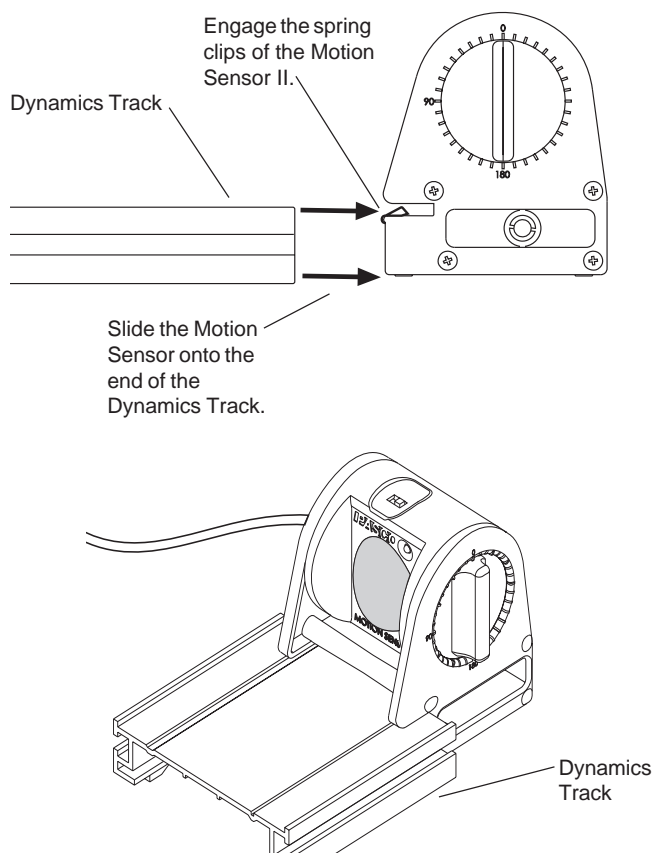
**Note:** When the *ScienceWorkshop* program is set to monitor or record data, the Motion Sensor II transducer will be triggered to produce the ultrasonic pulses that are used by *ScienceWorkshop* to determine the location of the target.

8. Adjust the angle of the transducer, the *Narrow/Std.* mode, and the trigger rate as necessary to achieve the optimal signal.

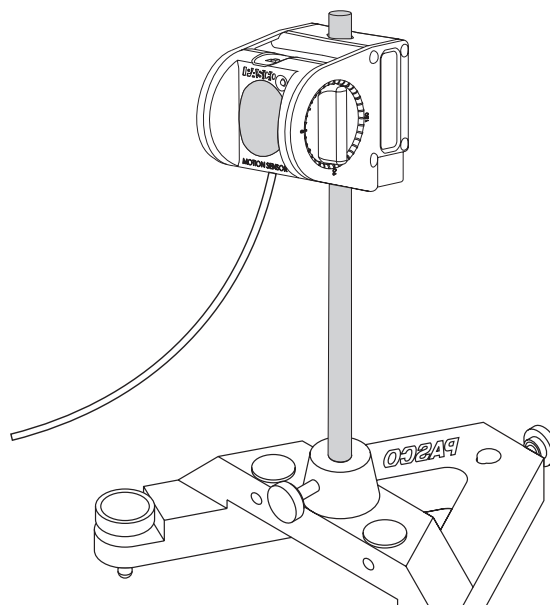
**Note:** The LED will light when the Motion Sensor II acquires the target.

9. You are now ready to record data.

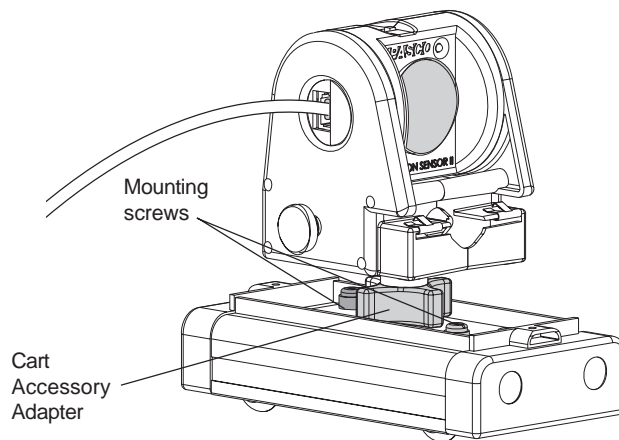
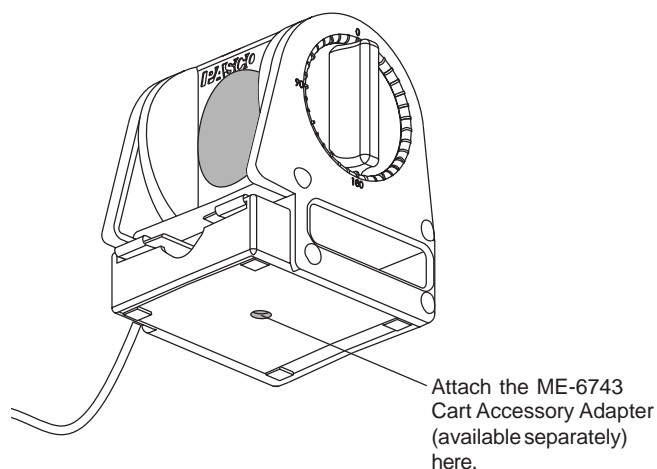
## Mounting the Motion Sensor II on PASCO equipment



**Figure 1**  
Mounting the Motion Sensor II on a Dynamics Track



**Figure 2**  
Mounting the Motion Sensor II on a rod stand



**Figure 3**  
Mounting the Motion Sensor II onto a Dynamics Cart

## Operation with CBL and EA-100 systems

An accessory cable (available separately, PASCO part no. 514-06862) is required for operation of the Motion Sensor II with a Texas Instruments CBL System™ or a Casio EA-100 Data Analyzer™.

An accessory cable (available separately, PASCO part no. 514-06933) is required for operation of the Motion Sensor II with a ULI interface.

## Theory of Operation

When triggered, the module produces a burst of 16 pulses at a frequency of about 49 KHz. This produces an audible click from the electrostatic transducer which functions as both a speaker and a microphone. The time between the *trigger* rising edge and the *echo* rising edge is proportional to the distance. The trip time for sound in air is about 0.3 ms/m, so an object at a distance of 0.6 m produces a round-trip time delay of 3.6 ms. The sound intensity decreases with distance, and for a round trip the attenuation can be large enough for the receiver to miss the echo. Therefore the gain of the receiver's amplifier is increased in discrete amounts in 11 steps where the maximum gain is reached in 38 ms. This increases the usable distance to about 8 meters with a highly reflective target. Operating the receiver at reduced gain at the beginning of the cycle reduces the circuit's sensitivity to false echoes.

**Note:** This instruction sheet was written assuming that the user is familiar with *ScienceWorkshop*. Users can gain familiarity by working through the tutorials provided with *ScienceWorkshop*.

**Motion Sensor II CI-6742**



**Tested To Comply  
With FCC Standards**

**FOR HOME OR OFFICE USE**

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio

frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/ TV technician for help.

## Limited Warranty

PASCO scientific warrants the product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. The warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment after repair will be paid by PASCO scientific.

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